Enriching Living Lab-Approaches For ICT Innovation By Introducing Different User Roles – A Case Study On The Gap Between Adoption Diffusion And Use Diffusion Of Digital TV In Flanders

ABSTRACT

We can characterize the contemporary ICT environment as an innovation spiral, with more and more innovative products, services and applications coming to the market, but also with a growing number of them not able to reach mass market or even a large enough market, resulting in a lot of innovations as well as failures. These failures become apparent through a lacking diffusion of the innovation, but also in terms of the incorporation of the innovation into the everyday life of the users, the so-called domestication or use diffusion. Attempts to cope with the inherent uncertainty and increasing complexity in the field of ICT innovation have influenced the rise of new, user-driven and open innovation-approaches. We contend that the Living Lab-approach can be seen as a systemic, methodological instrument incorporating a number of crucial insights linked to advances in innovation management and user research-literature. Currently however, the literature dealing with the 'user' as key stakeholder in the innovation process is still rather fragmented.

Within this paper we review a selection of user typologies that might play an important role for ICT-innovation: adoption diffusion segments, use diffusion segments and Lead Users. We investigate the occurrence of these user roles by means of a large scale survey for an important ICT innovation that is making its way into mass market adoption, but that however appears to lag behind in terms of use diffusion: digital television. Based on the results and observations, the relevance of these typologies within a Living Lab-research approach and the implications of the similarities and differences between them are discussed.

Keywords

Innovation diffusion, use diffusion, Lead Users, Living Labs, digital television, user centered innovation, user roles.

1. INTRODUCTION

Within our contemporary ICT environment, companies have ended up in the so-called 'innovation spiral' (Poiesz & Van Raaij, 2002). Because of a far-reaching globalization, growing competition and convergence, more and more innovations come to market. At the same time, more and more of these innovations fail to reach mass market (Slater & Mohr, 2006). Consumers perceive these (often merely incremental) innovations as less innovative and are less willing to adopt as they often have a 'too much, too soon'-feeling (Coutts, Coutts & Alport, 2005; De Marez, 2006). The success or failure of an innovation can be measured in a twofold way. Based upon the adoption diffusion paradigm of Rogers (2003), the degree of market adoption can be used to determine if the market introduction can be labeled as successful. Main reasons for the lack of adoption of an innovation are innovations not tailored to the users' needs and/or a bad introduction strategy (De Marez, 2006).

However, an innovation can be adopted by an individual, but remain un(der)used after its adoption. Research into the eventual usage innovation was highlighted by new paradigms such as 'social shaping' and 'domestication' that reacted against the apparent technological determinism of the adoption diffusion perspective (Haddon, 2006; Silverstone & Haddon, 1996). Frissen & Van Lieshout (2006) explicitly state that many ICT innovations fail because of the lack of 'use diffusion'. For this integration within everyday practices and routines, they use the term 'double articulation'. Research on ICT-adoption shows that users tend to reconstruct the innovation in terms of their current behavior, but that once the innovation finds its place in everyday practices and routines, the specific characteristics of ICT enable the potential to bring about substantial changes into those specific routines and practices. This

suggests research into this ‘double articulation’ in order to reduce the number of failed ICT-innovations. Main reasons for a lacking use diffusion are the absence of clear benefits or so-called ‘killer applications’ of the innovation.

In order to research failing innovations, the adoption diffusion as well as the use diffusion should be taken into account.

2. USER INVOLVEMENT

In order to tackle the previously described ‘innovation spiral’ and the resulting failures in terms of adoption and use diffusion, Slater et al. (2006) argue for the blending of insights from market/user research with those from innovation management. This means incorporating the principles of open innovation (Chesbrough, 2003), such as an iterative, cooperative innovation process extending beyond the boundaries of a single company, with a thorough focus on the end-user of the ICT innovation. This has induced companies to adopt more user-driven and user-led innovation strategies in order to stand out and attract attention (Ståhlbröst, A. & Bergvall-Kåreborn, 2008). These user-centric innovation processes try to take into account users’ expectations, experiences and needs, which was argued for by various scholars (Norman, 1998; Haddon & Paul, 2001; Edelmann et al., 2006). Hoogma & Schot (2001) add the environment in which the user interacts with the innovation as an important factor as they found that user innovativeness depends on the learning environment that is created in the innovation process. The goal is to grasp the complex interactions between products, users (and their different roles) and the multiple contexts in which these products are used.

In the next section, we will contend that the ‘blending’ of these insights has resulted in the Living Lab-concept, a state-of-the-art research methodology aimed at involving the users within the innovation process.

3. LIVING LABS

A possible research method incorporating the insights from the previous section comes under the form of the so-called 'Living Lab'-concept (Ståhlbröst, A. & Bergvall-Kåreborn, 2008). Erikkson et al. (2005) endorse to this viewpoint by stating that Living Labs could function as a means to meet the innovation challenges of ICT-providers. The term 'Living Lab' was introduced by Mitchell and is used to describe an experimental platform where the user is studied in his or her everyday habitat (Niitamo et al., 2006). It thus functions as an eco-system where users are subjected to a combination of research methodologies while they test new technologies that are still in development in their natural environment. This means that quantitative as well as qualitative research methods, with the focus on accessing the ideas and knowledge of the users regarding the tested technology, are being used within a Living Lab-setting (Eriksson et al., 2006). In order to stimulate Living Lab-research and further develop this research framework, several international organizations representing several industrial ICT Living Lab initiatives were launched. Some examples are the European Network of Living Labs (ENoLL), which was founded under the Finnish EU-presidency in 2006 and the Living Labs Europe-initiative (cf. ENoLL, 2007). These examples illustrate that the Living Lab-concept is strongly supported at the European policy-level as they are also tightly linked to the 'Strengthening innovation and investment in ICT research'-pillar of i2010, which is the EU policy framework for the information society and media (Peltomäki, 2008).

These Living Labs are mostly established through collaboration of private as well as public research partners and can be used with multiple iterations throughout the innovation process (Eriksson et al., 2005). This links Living Labs to the 'open innovation' perspective from innovation management literature, where innovation is seen as a non-linear and open process with cooperation and collaboration between different stakeholders (Chesbrough, 2003). In a Living Lab-setting, users are involved throughout the multiple stadia of the new product or

service development (Schaffers et al., 2007). In ideal circumstances, this translates into a close collaboration between designers and researchers, improving the innovativeness of the product or service (Boronowsky et al, 2006). Living Labs thus allow for a thorough user involvement throughout innovation processes with an 'open' character. We therefore label the Living Lab-approach for ICT innovation as the current 'state-of-the-art' methodology. However, we believe that two issues remain to be tackled: minimizing the conceptual ambiguity that still surrounds the Living Lab concept and incorporate different user roles within Living Lab-settings for an optimization of the innovation process.

3.1 Conceptual ambiguity

Despite its relatively new character, the Living Lab-concept has already been given a lot of different definitions, which sometimes seem to contradict each other. Living Labs have been called experimental platforms (Ballon et al., 2007), human-centric R&D-approaches (Eriksson et al., 2005), new arenas for innovation (Levén & Holmström, 2008) and even 'functional regions' (Corelabs, 2008). In the original 'American view', Living Labs were especially designed and equipped homes that replicated the 'normal' living circumstances of users as much as possible and where the to be tested technologies were available, whereas the 'European' Living Labs aim to bring the technology into the daily lives of the users as much as possible (see Katzy & Sung, 2006; Niitamo et al., 2006). Schuurman & De Marez (2009) also point to an ambivalent use of the term 'Living Lab', as it is used to describe a systemic innovation approach, but also to indicate a formalized institution that enables research with a Living Lab-framework. Regarding the actual research methods that should be used within Living Lab-settings, there is also no consensus yet, as the following quote illustrates: '… [A] living lab is not just a network of infrastructure and services, but much more a network of real people with rich experiences. Those experiences are the very thing making a living lab *living*, and therefore, research methods should be looking for ways to capture these social and

dynamic aspects.' (Mulder, Velthausz, & Kriens, 2008). This all suggests that the Living Lab-concept is still subject to a certain degree of conceptual ambiguity. Følstad (2008) confirmed this assumption while researching ICT Living Labs by means of a large literature review. He identified nine characteristics, of which only four occurred in all of the studied cases: discover unexpected ICT-uses and new service opportunities, evaluation of new ICT-solutions by users, familiar usage context for the users and medium- or long-term user studies.

3.2 User differentiation

Almirall (2008) identifies Living Labs as the first attempt to organize and structure user participation in real-life environments according to the open innovation paradigm. However, within the current Living Lab-literature, hardly any distinction is made between different kinds of users to be involved. We can again refer to the work of Følstad (2008) where the 'user' is mentioned in five of the nine identified general characteristics, without any differentiation. In our opinion, the user is currently too much seen as a supposedly well known uniform archetype. This belief is reflected in current practices, as existing businesses divide the user into business users and consumers. In reality, users have one identity that consists of multiple roles in different environments, which makes that needs and requirements are overlapping in many areas such as work, home and public (Edelmann et al., 2006). Lugano (2007) also suggests that the user conceptualization within innovation processes tends to be rather one-dimensional and pleads for a more complete user conceptualization. Research in the area of mobile applications has showed that bad user conceptualization has led to a number of applications that do not fit real user needs or practices, leading to under use of these services (Kämäräinen & Saariluoma, 2007). We believe that introducing user conceptualizations from different theoretical perspectives and mapping them to different 'user roles' within the innovation process would enrich the current Living Lab-approaches.

In the next section, we will focus on a first selection of different typologies that seem relevant for Living Lab-settings for ICT innovation. Later on, we will examine these user roles for a specific ICT innovation: digital television.

4. USER TYPOLOGIES

We start with the Lead User-concept, the only user type that has already been mentioned and used very often within the context of open innovation and Living Labs. The other two typologies, adoption diffusion segments and use diffusion segments, were selected based on the observation made in the introduction that ICT innovation success can be measured in terms of both adoption diffusion and use diffusion.

4.1 Lead Users

The origin of the Lead User-concept can be traced back to von Hippel. He first introduced the customer active paradigm (CAP), which implied that under certain circumstances the user could start innovating himself, as a counterweight to the dominant manufacturer active paradigm (MAP), where the manufacturer generates all innovation by himself (von Hippel, 1976). In later works, he extended the CAP to an interaction perspective, introducing the 'Lead User'-concept (von Hippel, 1986). He considered the employment of Lead Users as a counter weight for traditional market research that addresses users at the center of the market. Instead, the Lead User-approach focuses on users from the leading edge of the target market and even from markets facing similar problems in a more extreme form.

According to von Hippel (1986) Lead Users display two main characteristics with respect to a novel or enhanced product, process or service: a) Lead Users face needs months or years before they will be general in a marketplace and b) Lead Users expect to benefit significantly by obtaining a solution to these needs. Urban & von Hippel (1988) state that Lead Users are especially relevant '[w]hen new product needs are evolving rapidly, as in many high

technology product categories'. This makes the LU-concept very useful in the case of ICT-innovation and development. Schreier & Prügl (2008) follow von Hippel's definition and add some characteristics that influence the degree of 'Lead Userness': consumer knowledge & use experience, locus of control and innovativeness. They suggest these variables might be used as a proxy to identify Lead Users. Moreover, as Urban & von Hippel (1988) contend, detecting Lead Users can also be a proxy-method to detect user innovations.

4.2 Adoption Diffusion Segments

The first major paradigm to study innovation is the 'adoption diffusion'-perspective with Rogers as the founding father. According to this framework, the diffusion of innovations in a social system always follows a bell-shaped normal distribution in which innovators, early adopters, early majority, late majority and laggards can successively be distinguished with fixed segment sizes and based on their 'speed of adoption'. The central premise of this process of adoption and diffusion is that these different adopter categories each show their own unique characteristics (Rogers, 2003). **Innovators** are '*technology enthusiasts*' who appreciate innovation for its own sake. **Early adopters** are also called '*visionaries*'. They look to adopt and use an innovation in order to achieve a revolutionary improvement. The **early majority** or '*pragmatists*' look for evolutionary changes instead of revolutionary changes, aimed at enhancing their productivity. **Late majority** are '*conservatives*': risk averse, technology shy and price sensitive. The **laggards**, or '*skeptics*', only want to maintain the status quo (Slater et al., 2006).

Within the adoption diffusion-literature, these five categories are sometimes merged into a dichotomy of 'earlier adopters' versus 'later adopters' (Wei, 2001). The earlier adopters include the innovators and the early adopters, while the later adopters include early majority, late majority and laggards. The rationale behind this is that 'crossing the chasm' between early adopters and early majority is one of the most important obstacles for innovations

(Moore, 1991). The differences between the five segments are sometimes very small, while a dichotomous approach allows for a clearer profiling (De Marez, 2006).

4.3 Use Diffusion Segments

Criticism regarding the supposed technological determinism of the adoption diffusion-perspective and the lack of attention for the eventual usage of the innovation have led to the study of the 'use diffusion' of an innovation (see e.g. Robertson, 1984). This process of integration within everyday's context is also known as 'domestication' (Jankowski & Van Selm, 2001). This paradigm stressed the shaping of an ICT-innovation by social factors such as class, gender, culture or lifestyle (Haddon, 2006, Silverstone & Haddon, 1996, Van Den Broeck et al., 2004). Initially, it was based on a social deterministic point of view and mostly limited itself to descriptive qualitative research. However, Shih & Venkatesh (2004) propose a user categorization based on quantitative research into use diffusion. The categorization relies on two parameters: the *variety of use*, which refers to the different ways in which the innovation is used, and the *rate of use*, which refers to the time that is spent using the innovation. This results in four user categories: limited users, non-specialized users, specialized users and intense users. **Limited users** do not spend much time using the innovation and also show a limited range of use variation. **Non-specialized users** can also be called 'experimental users', as they show a high variety of use, but only for a limited amount of time. **Specialized users** spend much time using the innovation, but only for a limited variety of tasks or goals. **Intense users** use the innovation for a wide variety of applications and spend much time doing this. It is suggested that users can shift between these categories over time.

4.4 Relevance of user roles in Living Lab-settings

A number of authors have already discussed the involvement of Lead Users in Living Lab-research. In this respect, Eriksson et al. (2005) explicitly argue for a better integration of Lead

User-theory within Living Lab-approaches. Löh (2008) makes a first attempt and sees Living Labs as an alternative for the classical innovation approach, grounded within three theoretical backgrounds: involving the customer, open innovation and Lead Users. Almirall (2008) also pairs Living Labs with open innovation and Lead Users. He considers user involvement as an emergent process without governance and without any attempt to systematize it and sees 'Lead Users' as one of the possible forms of this involvement. Living labs, on the contrary, represent the first attempt to organize and structure user participation in real life environments. In this view, Living Labs act as facilitators for the massive filtering problem, i.e. selecting the most appropriate partner or the most suitable idea; a problem that companies have to cope with in an environment characterized by open innovation. Almirall (2008) also suggests that Lead Users are more willing to participate within Living Lab-research because they are motivated to be involved. Kusiak (2007) explicitly mentions the use of Lead Users in two stages of the ICT-innovation process: idea generation and concept evaluation.

However, we believe that the discussed adoption diffusion and use diffusion segments also have a lot of potential in the context of Living Lab innovation processes. Regarding the former, Moore (1991) identified a chasm between the visionaries(early adopters) and the pragmatists (early majority). A major challenge for all innovations lies in the crossing of this chasm (De Marez, 2006). Gladwell (2001) conceptualizes this as an innovation overcoming the 'tipping point' in order to reach a larger group of users. It seems that research into the different needs and wants of the visionaries and the pragmatists is necessary in order to come to an innovation that is able to cross the chasm. Main problem is that the adoption diffusion segments of the innovation have to be predicted to accurately study the differences between these two groups. This can be achieved by using the Product Specific Adoption Potential (PSAP) scale (De Marez, 2006; De Marez & Verleye, 2004; De Marez et al., 2008; cf. infra). Once identified, visionaries as well as pragmatists should be further used within the Living

Lab in order to tailor the innovation towards the needs and wants of both groups. The visionaries seem better suited for the earlier stages of the Living Lab, as they are by definition more open to innovation and can better serve as creative input sources. The pragmatists should be used in later stages to further assess the full market potential of the innovation.

The categorization of users based on use diffusion can be used as a constructive way to visualize the market (Shih & Venkatesh, 2004). This way, a segmentation based on use diffusion can also prove to be fruitful during the innovation process. However, a similar problem arises as with the adoption diffusion segments. As the innovation is not yet available, these segments have to be predicted. A Living Lab-approach can possibly provide a solution here. When an innovation can be used in a Living Lab-setting by a large enough user group, measures regarding usage intensity and usage diversity can be obtained from the Living Lab-participants. This would allow to categorize them into the four given usage diffusion-segments and further segmentation could be applied to describe the differences between the segments. The behavior of these different use segments should provide vital information regarding the innovation in development. In earlier stages of the Living Lab-setting, proxy technology assessment (PTA) could be used to identify some users within the different use segments, which could be used later on in the innovation process (Pierson et al., 2006).

4.5 Relations between user roles

Within this paragraph, we will shortly review what can be extracted from current literature regarding the (possible) co-occurrence of the different user typologies in the specific case of ICT innovation.

A largely hedonistic motivation is ascribed to innovators for their adoption of technology (Wei, 2001). This implies adopting technology for the sake of technology, hinting at trying out the possibilities. This would result in a non-specialized usage, trying out a lot of things, but losing interest quickly, so no applications would be used on a regular basis. For early

adopters, a practical motivation is supposed to be dominant, so this group seems more likely to show a more advanced use diffusion in the form of intense or specialized usage (Slater et al., 2006). The early majority is supposed to adopt for very specific reasons, seeking to fulfill certain needs (better), so a specialized usage could be expected here (Slater et al., 2006; Wei, 2001). Shih & Venkatesh (2004) propose a link between Lead Users and intense users. They found that intense users represent the highest level of use innovativeness and argue that they can thus be linked in many respects to Lead Users.

The most literature can be found regarding the similarities and differences between Lead Users and innovators, but opinions vary. Schoormans & De Bont (1995) simply equal Lead Users to innovators, as they see Lead Users as consumers that are expected to be the first users of a new product in 'their' market. This view is however challenged by Morrison et al. (1999) who see a connection between Lead Users and innovators, but not an equation. They state that '[e]mpirical Lead User studies […] tend to also find that Lead Users are early adopters of new products and services.' (id., 2004). As a result, the LU-concept should be more compatible with the 'innovators' from diffusionism. Schreier et al. (2007) take another stance. They think that the traditional diffusion curve is not applicable to Lead Users because of significant differences between Lead Users and innovators. Lead Users experience a certain need prior to the development of an innovation to solve this need. This motivates Lead Users to search for a solution themselves. However, when an innovation that meets this specific need enters the market, it is likely that these 'innovating' Lead Users will not be innovators in the diffusionist sense, as this specific need is no longer present. This reasoning finds some evidence within innovation literature which sees the desire to gain status as an important motivation for early adoption (see Brown & Venkatesh, 2003; De Marez, 2006; Rogers, 2003), while this motivation is nowhere mentioned in LU-theory.

5. EMPIRICAL EXPLORATION OF USER ROLES: CASE DIGITAL TV

We will examine these user roles for a specific ICT innovation that has recently passed the 50% market adoption threshold in Flanders: digital television (Snoeck, 2009b). We will further look into the possibilities of these user roles in the context of a Living Lab for service innovation for digital TV.

5.1 Methodology

In order to explore the possible added value of taking into account different user roles for ICT innovation in Living Lab-contexts, we set up an empirical research for an innovation that is currently moving firmly into mass market in Flanders: digital TV. In September 2009, an online survey was held containing questions regarding the possession and usage of digital TV. The respondents were also asked to indicate whether they had unfulfilled needs with regards to digital TV. This way, the different user roles could be identified.

An invitation together with a link to the survey was sent to a panel of 46.000 customers of a large telecom operator, offering internet, mobile telephony, regular telephony and digital TV: Belgacom. Several quota on gender, age, region etc. were used to select these addresses from the customer database. The resulting sample was weighted on sex, age (starting from 20 years old) and province, resulting in 13.312 cases. We decided to only consider respondents from 20 years onwards because teenagers remained heavily underrepresented and they are in most cases not responsible for important purchases. This means a very satisfactory response rate of nearly 30% was attained. From the resulting 13.312 cases, only the respondents already owning digital TV were selected. This resulted in 11.802 users of digital TV that are taken into account for the results, presented in the rest of this paper.

5.2 Adoption Diffusion Segments

Within the sample of digital TV users, the respondents could be assigned to the adoption diffusion segments by simply surveying their time of adoption for digital TV. The table below shows the results.

Table 1: Time of adoption

Adoption period	%
July 2005 - December 2005	3,3
January 2006 - June 2006	3,3
July 2006 - December 2006	4,5
January 2007 - June 2007	8,2
July 2007 - December 2007	15,4
January 2008 - June 2008	17,0
July 2008 - December 2008	19,9
January 2009 – now	28,3

In order to determine the adoption diffusion category, we took into account two parameters. First, the evolution in the actual number of users of digital TV, and second, the predicted adoption diffusion, based on the PSAP-method. This estimation of the adoption potential of digital TV in Flanders was carried out in 2004 (De Marez, 2006). To this end, a weighted sample of 1005 people was surveyed using the PSAP-methodology (De Marez & Verleye, 2004). The PSAP scale is an intention-based survey method in which respondents are allocated to innovator, early adopter, majority and laggard segments. This allocation is based on the answers on a five point Likert scale for a general adoption intention question and on

two questions tailored for each respondent gauging their intention for 'optimal' and 'suboptimal' product offerings. This method allows to make a prediction of the size of the adoption segments of Rogers (2003). The research on the adoption potential of digital TV in Flanders was one of the case studies in which the PSAP-methodology was validated (De MArez, 2006). Figure 1 shows the potential of digital TV for Flanders in 2004, together with the classical Rogers curve.

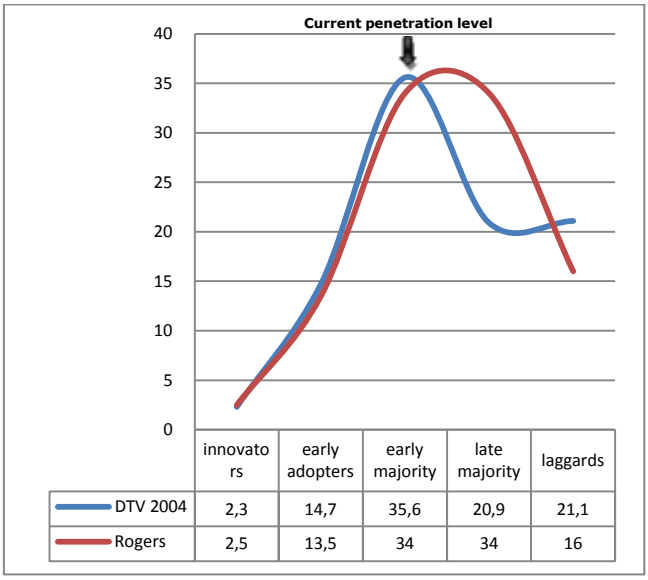

Figure 1: Adoption potential forecast DTV 2004 (De Marez, 2006)

For the first three segments (innovators, early adopters and early majority), the predicted adoption potential resembles the classical clock distribution very closely. However, a large drop occurs between the early majority and late majority segments, which automatically implies a larger laggard-segment.

As digital TV became available in Flanders during 2005, it is possible to compare the predicted adoption curve with the actual adoption levels of the technology. In the first quarter of 2006, 140.000 households had adopted DTV, which equals the innovator-segment from the prediction. The numbers from the third quarter of 2006 and the first quarter of 2008 are also closely related to the PSAP-prediction, indicating that the early adopter-segment has adopted DTV (Snoeck, 2009a; De Tijd, 2007). Currently, the adoption rate has just passed 50%

(Snoeck, 2009b), meaning that the adoption has moved firmly into the early majority segment, and indicating that DTV has become a mass market-technology.

This means that within our sample, adopters from the first period (July 2005 – December 2005) are considered innovators. People adopting between January 2006 and December 2007 belong to the early adopters, while the remaining digital TV users are labeled as early majority.

Table 2: Adopter segments within the sample

	%
Innovators	3,3%
Early Adopters	31,5%
Early Majority	65,3%

This results in our sample being divided into 3,3% Innovators, just under one third Early Adopters and just below two thirds Early Majority.

5.3 Use Diffusion Segments

The use diffusion of digital TV was measured by surveying the actual usage of the different (interactive) possibilities of DTV on a five point scale, ranging from 'never' to '(almost) daily'. The results, which can be found in the table below, confirmed our hypothesis that the usage of interactive applications for digital television remains fairly minimal.

Table 3: Use of interactive applications

	Never	**< once a month**	**Once a month**	**Once a week**	**(almost) daily**
Consult EPG	20,0%	7,8%	6,3%	19,0%	46,8%

Record program with STB	31,9%	7,2%	9,3%	28,6%	22,9%
Free VoD	44,2%	25,4%	17,6%	9,8%	2,9%
Paid VoD	44,9%	27,0%	20,4%	7,1%	0,6%
Info through red button	61,4%	18,9%	10,0%	7,8%	1,9%
Reminder in EPG	62,4%	11,1%	7,9%	11,8%	6,8%
Competition/televoting with red button	83,1%	14,0%	2,2%	0,6%	0,1%
Consult 'Gouden Gids'	88,8%	8,0%	2,3%	0,7%	0,1%
Consult train schedule	89,7%	7,1%	2,3%	0,7%	0,2%
Watch Picasaweb photos	91,5%	4,3%	2,6%	1,2%	0,4%
E-government	95,6%	2,6%	0,8%	0,8%	0,3%
Gaming on digital TV	97,2%	1,8%	0,4%	0,3%	0,2%
E-mail on digital TV	98,3%	0,8%	0,2%	0,2%	0,5%

With the figures from Table 3, we can now develop a syntax to assign all users to the four use diffusion segments, i.e. limited users, non-specialized users, specialized users and intense users. 'Consult EPG' was not taken into account for the user categorization, as it is the most common application with the least 'interactive' character.

Intense users were defined as people using at least four of the twelve applications at least once a week. **Specialized users** use at least one and maximum three applications at least once a week. Respondents were categorized as **non-specialized users** when they did not use any of the applications on a weekly basis, but used at least four once a month. The remaining users, using less than four applications once a month, were labeled as **limited users**. The following table gives the distribution of the respondents among these four categories.

Table 4: Use diffusion segments

Use diffusion category	%
Limited users	30,7%
Non-specialized users	5,8%
Specialized users	61,1%
Intense users	2,4%

Specialized users, or users that use one to three applications quite intensely, account for the majority of the sample with 61,1%. Limited users are the second biggest segment with 30,7%. This means that these two segments contain already more than 90% of all digital TV users from the sample. With 5,8% and 2,4%, non-specialized and intense users respectively are clearly much smaller segments. It appears that the majority of the digital TV users only uses a few applications, be it on a regular or less regular basis.

Table 4 shows the percentages of monthly users of the different applications for limited and non-specialized users. Note that the limited users also include users that do not use any of the applications at all.

Table 5: Use of interactive applications on a weekly basis for limited and non-specialized users

	% Lim users	% Non-spec users
Paid VoD	30,8%	81,3%
Free VoD	27,3%	82,8%
Record program with STB	24,3%	71,4%
Info through red button	15,2%	66,5%
Reminder in EPG	7,9%	48,0%

Competition/televoting with red button	5,8%	37,1%
Consult train schedule	5,7%	24,9%
Consult 'Gouden Gids'	4,2%	27,5%
Watch Picasaweb photos	3,7%	18,5%
E-government	1,1%	12,0%
Gaming on digital TV	0,4%	7,1%
E-mail on digital TV	0,2%	3,6%

For both limited and non-specialized user groups, VOD-applications are clearly the most popular. Recording and info through the red button come in third and fourth for both segments. All other applications are clearly less popular than these four, with percentages dropping below 10% for the limited users and below 50% for the non-specialized users.

Table 5 shows the percentages of monthly and weekly users of the different applications for specialized and intense users.

Table 6: Use of interactive applications for specialized and intense users

	% Spec users		% Intense users	
	Monthly	Weekly	Monthly	Weekly
Record program with STB	8,1%	80,4%	0,5%	98,4%
Free VoD	48,8%	17,1%	1,4%	96,6%
Reminder in EPG	22,2%	27,2%	7,7%	81,8%
Paid VoD	53,4%	10,1%	26,1%	63,7%
Info through red button	32,5%	13,5%	19,9%	59,9%
Competition/televoting with red button	18,7%	0,8%	36,0%	10,2%

Watch Picasaweb photos	7,3%	2,2%	10,0%	9,8%
Consult train schedule	9,5%	1,1%	18,5%	9,2%
Consult 'Gouden Gids'	11,2%	1,1%	24,6%	8,8%
E-government	3,5%	1,5%	7,4%	7,7%
Gaming on digital TV	2,4%	0,7%	8,1%	5,5%
E-mail on digital TV	1,1%	0,9%	2,6%	6,2%

It appears that specialized usage of digital TV mainly involves recording, with 80,4% of all specialized users doing this on a weekly basis. Putting a reminder in the EPG comes in second with only 27,2%, and free VOD third with 17,1%. Paid VOD with 10,1% weekly users occupies the fifth place, behind red button info, but is the most popular monthly application with 53,4%.

Intense users most frequently use the recording function (98,4%), free VOD (96,6%) and putting a reminder in the EPG (81,8%). Paid VOD comes in fourth place (63,7%), closely followed by red button information (59,9%). All other applications score much lower, which again indicates that even the intense users most often make use of a selected set of applications.

We can conclude that the majority of digital TV users displays an only limited degree of use diffusion, as only very few applications are regularly used and both segments with a high variety of use, intense and non-specialized users, are very scarcely represented within our sample. In other words, there seems to be a lag between adoption diffusion, where the 50% adoption threshold was recently reached (cf. supra), and use diffusion.

5.4 Lead Users

In order to possibly identify Lead Users within the surveyed sample, we simply asked the respondents by means of an open question whether they wanted to be able to do certain things

with digital TV which were currently not possible. This resulted in 3563 ‘ideas’, or almost one out of three digital TV viewers expressing an apparently ‘unfulfilled’ need. However, when going through all the answers, the vast majority of them concerned very common applications, features or possibilities. Most of these ‘needs’ are already possible with other digital TV providers or contain straight forward suggestions such as ‘internet’ or ‘an EPG that extends further into the future’.

Eventually, of all 3563 initial answers, 34 were selected as containing a possible Lead User-idea. This resulted in 13 unique ideas, as some respondents had the same idea or some separate ideas could be clustered into one main Lead User-idea. These ideas are: 1) 3D images, 2) community-functions through DTV, 3) DTV as an embedded open source platform where everyone can develop applications, 4) the set top box replaces all gaming consoles, 5) automatic subtitling of all channels and content, 6) ‘mailing’ of recorded programs or content to other users, 7) ratings and recommendations through DTV, 8) ‘smart home’ applications through DTV, 9) syncing functionality with PC, laptop and/or mobile, 10) the exchange of user generated content through DTV, 11) video surveillance integrated in DTV, 12) virtual digicorder, i.e. the possibility to access the STB from elsewhere (e.g. online, sms,…), and 13) a visual EPG (image-based).

In order to validate the Lead Userness of these 13 ideas, an expert panel of 15 Flemish digital TV experts was recruited, including experts from all major telecom-companies and content providers. Although opinions regarding the degree of Lead Userness of the different ideas differed, all of them were considered at least somewhat innovative and as having the possibility to appeal to a reasonable market share within 5 year’s time.

However, for all ideas, according to the experts, some companies or players within the (international) digital TV-environment are already busy developing these ideas. In other words, none of the ideas generated by our user sample could be labeled as really

'groundbreaking'. We therefore will not use the term 'Lead User' for these respondents, but indicate them as users with a Lead User-idea. In other words, our approach did not result in the detection of real Lead Users with truly ground breaking ideas.

5.5 User Roles Combined

The following table shows the percentage of the adopter segments within the use diffusion categories, together with the total percentages for the whole sample. The Chi² value indicates that the differences are all statistically significant.

Table 7: Adoption diffusion and use diffusion segments combined

Chi² = 0,000	Limited Users	Non-Specialized users	Specialized Users	Intense Users	Total
Innovators	3,8%	2,7%	2,9%	7,4%	3,3%
Early Adopters	30,3%	32,3%	31,9%	33,6%	31,5%
Early Majority	65,9%	65,1%	65,2%	59,0%	65,3%

Within the category of the limited users, we see a small underrepresentation of early adopters, while this category is slightly overrepresented within the group of non-specialized users. The group specialized users differs the least from the general percentages. The differences are the most notable within the group intense users. The innovator-segment is more than twice the size as in the total sample. The early majority segment is clearly underrepresented, with less than 60% of the intense users belonging to this segment, where for the other three use diffusion categories this percentage is above 65%.

When taking into account the respondents with Lead User-ideas, 3 can be labeled as innovators (8,8%), 12 are early adopters (35,3%) and the remaining 19 belong to the early majority (55,9%). Compared to the total sample, innovators and early adopters are

overrepresented. In terms of use diffusion, none of the respondents with a Lead User-idea can be labeled as intense user, 23 are specialized users (67,6%), 3 are non-specialized users (8,8%) and 8 are limited users (23,5%). This means that compared to the total sample, non-specialized users and specialized users are overrepresented.

6. DISCUSSION

We will now look back at the assumptions we made regarding these user roles and assess which ones are confirmed and which ones are contradicted by our data.

For innovators, theory supposes a hedonistic motivation for their early adoption. This would result in trying out all applications, but without a clear goal or without looking for a specific benefit, thus quickly losing interest. This resembles non-specialized users the most. Our results contradict this assumption. Innovators appear to be quite strongly overrepresented amongst the intense users, and slightly overrepresented amongst the limited users.

For the early adopters, a more practical motivation for adoption is assumed, making it more likely that they show a more advanced use diffusion. We indeed notice a slight overrepresentation of early adopters amongst the intense users and a light underrepresentation with the limited users. The differences are however quite small.

For the early majority, it is expected that they adopt for very specific reasons, seeking clear benefits from the new technology. This would imply a more specialized use. However, again this assumption is not entirely confirmed, as the only slight overrepresentation occurs at the limited users-segment. The most eye-catching is the modest underrepresentation amongst the intense users.

The literature regarding the relation between innovators and Lead Users showed mixed opinions, but it was often suggested that Lead Users would not equal innovators. Within our

sample, we could detect some Lead User-ideas for which an expert panel assessed at least some market potential, but none was really groundbreaking as for each idea at least four experts indicated that some companies or players in the international field of digital television were already busy developing these. Within our sample, innovators and to a lesser degree early adopters were more likely to generate Lead User ideas, and for the use diffusion segments, this was the case for the non-specialized and specialized users. It was striking that none of the intense users came up with a Lead User idea, although literature suggested that there would be a link with Lead Users. However, as we also argued that with our identification method, we were not able to identify any 'true' Lead User, we cannot simply reject this assumption based on our findings. Another possible explanation could be that intense users have fully embraced most digital TV applications and have no strong needs for other applications or services.

The fact that non-specialized users are relatively the most overrepresented among the users with a Lead User-idea comes perhaps less as a surprise. As this group has tried a broad range of applications, but do not use them on a frequent basis, this might indicate that they are disappointed with the current offering and still have some unfulfilled needs regarding digital TV. Specialized users clearly find a few applications very interesting, but might also have some needs that cannot be fulfilled by the current offering of services and applications.

With regards to the findings from the first part of this paper, we believe that a Living Lab-approach taking into account the different described user typologies could be used to overcome the current lack of use diffusion for an innovation with a successful adoption diffusion. Research into the mismatch between expectations and eventual usage could lead to ideas for new services/applications, which could be co-created and –designed by different users, recruited based on their time of adoption and degree of application usage. The

identified Lead User-ideas could be used as a starting point, but other ideas should be taken into account as well.

Limited and non-specialized users could be used to develop services to drive the lacking use diffusion, while current non-adopters could also be taken into account to further stimulate the adoption diffusion. The developed services and/or applications could then be tested by making them available to selected user panels, containing the different identified user profiles, and possibly redesigned or redeveloped, making them more tailored towards the different user segments and their different needs and wants. This could eventually lead to the closing of the current gap between adoption diffusion and use diffusion for digital TV.

7. CONCLUSION

Within this paper, we have argued that the Living Lab-approach can be seen as the current state-of-the-art methodology for ICT innovation and as a possible means to overcome failing innovations in terms of adoption diffusion as well as use diffusion. However, we identified two issues with regards to these Living Labs: an apparent conceptual ambiguity, asking for a more rigid theoretical framework, and a limited user conceptualization. We therefore proposed enriching Living Lab-processes with different user typologies, such as the adoption diffusion segments, use diffusion segments and Lead Users. We showed that each of these user roles might provide additional value when taken into account during specific stages within a Living Lab innovation process. We took digital television, an ICT innovation firmly moving into mass market nowadays, as a case study to examine the (co-)occurrence of these user roles. Some tendencies could be distinguished among these results, but further research is definitely needed to further clarify the relationships between these user typologies.

What was more striking, was the apparent lag between adoption diffusion of digital TV, which amounts to 50% market penetration in Flanders, and the use diffusion, with only very

few applications being used regularly, and even a lot of adopters hardly using any of the possibilities of digital TV. This indicates a mismatch between the expectation of adopters and existing services and applications of digital TV. We tried to identify Lead Users by means of an open question in a user survey, but this only yielded 13 unique Lead User ideas, which all have some potential according to an expert panel, but with none being truly groundbreaking. None of the 34 users that generated one of these 13 ideas could thus be labeled as a true Lead User.

Although not all results were evenly satisfying, and alternative approaches for identifying Lead Users and determining to which segments users belong should be tested, we hope to have demonstrated to possible added value when taking a broader user conceptualization in Living Lab-research. This should pave the way for more focused user-centered research and eventually for ICT innovation more tailored towards the user.

8. FUTURE RESEARCH FOR DIGITAL TV

Based on the findings from these paper, future research would have to further investigate the apparent gap between adoption diffusion and use diffusion for digital television in Flanders. Within a Living Lab-research approach, the market potential and the concrete feasibility of the generated Lead User-ideas could be tested and further fine-tuned in an iterative manner, using a segmented approach based on the use diffusion and adoption diffusion segments. In order to generate more groundbreaking Lead User ideas and to assess the co-occurrence of Lead Users with the other user typologies, other Lead User detection methods, such as e.g. pyramiding, should be used to identify 'true' Lead Users. Future research should also think of more strict ways to determine membership to the use diffusion and adoption diffusion segments, as this might possibly have impacted the results presented within this paper.

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